Rec'd PCT/PTO 18 APR 2005
PCT/AU03/01415
10/531759
REC'D 17 NOV 2003
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I, JANENE PEISKER, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. 2002952276 for a patent by UNIVERSITY OF TECHNOLOGY, SYDNEY as filed on 24 October 2002.

WITNESS my hand this
Tenth day of November 2003

JANENE PEISKER
TEAM LEADER EXAMINATION
SUPPORT AND SALES

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# PROVISIONAL SPECIFICATION

**Applicant(s):**

UNIVERSITY OF TECHNOLOGY, SYDNEY

**Invention Title:**

A LIGHT TRANSFER COMPONENT

The invention is described in the following statement:

A LIGHT TRANSFER COMPONENT

Field of the Invention

The present invention broadly relates to a light transfer component for use in a daylight collection and transfer system.

Background of the Invention

Electrical lighting systems are often very inefficient; usually more than 90% of the electrical energy is not converted into useful light. Sunlight, however, is freely available and attempts have been made to collect sunlight for illumination purposes.

US Patent 6059438 discloses a sunlight collecting and transmitting system. The disclosed system comprises three substantially flat collector sheets. The three sheets are stacked on top of each other and are composed of a polymeric material that is doped with fluorescent dye molecules. The dye molecules absorb sunlight of a particular wavelength and subsequently emit fluorescent light having a slightly longer wavelength. A first sheet is doped with blue dye molecules, a second sheet is doped with green dye molecules and a third sheet is doped with red dye molecules. The generated fluorescent light is guided by internal reflection within the collector sheets and white light can be generated by combining the blue, green and red fluorescent light. One of the advantages of this sunlight collecting and transmitting system is that both the absorption of the incoming light and the emission of the fluorescent light do not occur in any preferred directions. The efficiency of such a system therefore is largely independent of the direction of the incoming sunlight.

The generated light needs to be guided from the collector sheets into buildings to illuminate the interior of the buildings. However, as the light is guided by total internal reflection, light transference losses occur if geometrical constrains are not satisfied which is a problem for the transfer of sunlight in a convenient and efficient manner. For example, it would be useful to transfer light by cable-like conductors.

US Patent 6,272,265 discloses that the output of a fluorescent sunlight collector and transmission system can potentially be greatly increased if the system is constructed so that it is optically continuous i.e. without air gaps along the optical path.

Summary of the Invention

The present invention provides a light transfer component formed from a material that is transparent for light of a predetermined range of wavelengths, the light transfer component having:

- a first portion that has two substantially parallel surfaces, and
- a second rounded portion,

the light transfer component being arranged such that light directed from the first portion to the second portion will not experience a reduction in cross-sectional area of the material through which, in use, light is guided from the first portion to the second portion.

For example, the first portion may comprise a rectangular sheet, the substantially parallel surfaces being the top and the bottom of the sheet. The first portion may take any form in which the two surfaces are substantially parallel, including bent and corrugated shapes, but preferably is of a substantially rectangular

cross-sectional shape.

The second portion preferably is of a hollow ring like cross-sectional shape.

Throughout this specification the term "rounded" is used for any shape that is non-angular. For example, this may include oval shapes or generally curved shapes. Also, the term "cross-sectional area" is used for "the cross-sectional area measured transversely to the mean direction of light propagation unless explicitly otherwise defined. The term "substantially parallel" is used for surfaces that are parallel or that are oriented relative to each other such that they are almost parallel.

The inventors have determined that collectors for sunlight preferably are of a form that has substantially parallel top and bottom surfaces and most preferably are of a substantially flat form. However, the light most conveniently is guided in an optical cable having a generally cylindrical form such as a flexible, solid and round polymeric cable preferably having a diameter of 20mm or less. The above-defined light transfer component provides a link between such a light collector sheet and the optical cable and enables the efficient transfer of light through the link.

The present invention also provides a light transfer component having:

- a first portion having two substantially parallel surfaces, and
- a second hollow portion being of a ring-like cross-sectional shape and being arranged for connection to a hollow-to solid coupler.

The present invention further provides a light transfer component having:

- a first portion having two substantially parallel

surfaces, and

- a second hollow portion being of a rounded cross-sectional shape that is solid and being arranged for connection to an optical cable.

The above-defined light transfer component preferably is arranged such that, in use, light guided from the first portion to the second portion will experience a gradual transition in the cross-sectional and longitudinal profiles of the light transfer component. The changes in profile most preferably is sufficiently gradual such that there are no bending losses of the light inside the light transfer component.

The local refractive index n preferably is constant throughout the light transfer component. The cross-sectional area preferably is constant throughout the light transfer component and the solid angle of the propagating light most preferably is also substantially constant throughout the light transfer component.

In one embodiment of the present invention the light transfer component is arranged for connection to an optical cable and most preferably is arranged for face-to-face connection with an optical cable. In this case the second portion preferably is of a rounded cross-sectional shape that is solid and the light transfer component most preferably comprises an intermediate portion that is hollow.

In another embodiment of the present invention the light transfer component is arranged for connection to a coupler. In this case the second portion preferably is of a hollow ring-like shape. The coupler preferably is arranged to provide a connection to the optical cable. The coupler preferably is a round hollow-to-solid coupler.

The first portion preferably is arranged for direct

connection to a collector sheet. In this case the first portion preferably is arranged for face-to-face connection with the collector sheet.

Alternatively, the first portion may comprise a light collector sheet doped with dye molecules and arranged for absorption of sunlight and emission of fluorescent radiation. In this case the light collector sheet and the light transfer component preferably are formed as an integral part.

The light transfer component preferably is formed from a transparent material with a refractive index that approximates that of the collector sheets. The material preferably is a polymeric material such as poly methyl methacrylate (PMMA).

Preferred embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings.

Brief Description of the Drawings

Figure 1 shows a perspective representation of a light transfer component according to an embodiment of the present invention,

Figure 2 shows a perspective exploded view of a light collector component according to another embodiment of the invention and

Figure 3 shows a ray-tracing diagram of the light transfer component.

Detailed Description of a Preferred Embodiment

Referring to Figure 1, a light transfer component is now described. In this embodiment the light transfer component 10 has a rectangular portion 12 and a hollow, ring-like portion 14. The rectangular portion 12 is shaped

such that it may be joined face-to-face with a light collector sheet (not shown).

The rectangular portion 12 has an end-face 16 that has the same cross-sectional shape as the light collector sheet. In use, the end-face 16 is joined with the light collector sheet using a suitable optically transmissive adhesive.

The hollow, ring-like portion is arranged to be connected to a further light transfer component such as a hollow-to-solid coupler which is connected to an optical cable (both not shown).

It will be appreciated that, alternatively, the rectangular portion 12 may form a part of a light collector sheet. In this case, the light collector sheet and the light collector component are formed as one integral part.

US Patent 6,272,265 discloses ways in which the output of a fluorescent sunlight collector and transmission system can be substantially increased provided that the system is constructed so that it is optically continuous i.e. without air gaps along the optical path.

Fluorescence light that is generated in the light collector sheet is guided into the light transfer component 10. The light transfer component 10 is shaped such that light guided from the substantially rectangular portion 12 to the ring-like portion 14 will experience a gradual transition and will not experience a reduction in the cross-sectional area. The transition occurs over a distance corresponding to several times the width of the sheet from which the light transfer component is formed. The light transfer component is shaped such that minimal bending loses occur when light is guided through the light

transfer component.

In this embodiment the light transfer component 10 is formed from PMMA. The light transfer component 10 may be prepared by injection moulding or by casting. All surfaces are optically smooth to reduce optical scattering losses. If required, surface roughness may be reduced by dipping the light transfer component 10 into a solution of dimethyl methacrylate. The edges are arranged that right angles are formed whereby loss of light transported by total internal reflection is reduced.

The end-face of the ring-like portion 14 may also be joined directly with an end-face of the optical cable without a hollow-to-solid coupler. In this case the ring-like portion 14 preferably has an outer diameter that matches the outer diameter of the light guiding portion of the optical cable.

Figure 2 shows and exploded perspective view of another embodiment of the present invention. In this embodiment the light transfer component 20 comprises portion 22 which has a hollow and ring-like end-face 23 and an opposing rectangular end-face 24. The ring-like end-face 23 is joined to a hollow-to-solid coupler 24 such that the light transfer component comprises an intermediate portion that is hollow. It will be appreciated that the portion 22 and the hollow-to-solid coupler 24 may also be formed as one integral part. The hollow-to-solid coupler has a round end-face 26 that is solid and is arranged for coupling to a polymeric optical cable 28. The rectangular end-face of portion 24 of the portion 22 is arranged to be joined to a light collector sheet 30.

Figure 3 shows a ray-tracing diagram for the light transfer component 10 shown in Figure 1. Dye molecules 40

may emit fluorescence radiation in a variety of directions and the radiation is guided by total internal reflection towards the ring-like portion 14. The Figure shows an arbitrary selection of possible ray traces.

Even though this invention has been described in the context of a light collection and transfer system that absorbs sunlight and generates fluorescence radiation, it will be appreciated that the invention has broader applications. For example, the light transfer component may be used for a light collection and transfer system that transfers collected sunlight directly.

It is to be understood that the references that are made to US Patents 6059438 and 6272265 do not constitute admissions that these documents form part of the common general knowledge in the art, in Australia or any other country.

Although the invention has been described with reference to particular examples, it will be appreciated by those skilled in the art that the invention may be embodied in many other forms.

The claims defining the Invention are as follows:

1. A light transfer component formed from a material that is transparent for light of a predetermined range of wavelengths, the light transfer component having:

- a first portion that has two substantially parallel surfaces, and
- a second rounded portion,

the light transfer component being arranged such that light directed from the first portion to the second portion will not experience a reduction in cross-sectional area of the material through which, in use, light is guided from the first portion to the second portion.

2. The light transfer component as claimed in claim 1 wherein the first portion is of a substantially rectangular cross-sectional shape.

3. The light transfer component as claimed in claims 1 or 2 shaped such that the guided light will experience a gradual transition from the first portion to the second portion.

4. The light transfer component as claimed in any one of the preceding claims wherein the transition is sufficiently gradual such that no bending losses of the guided light occur.

5. The light transfer component as claimed in any one of the preceding claims wherein the local refractive index n is constant throughout the component.

6. The light transfer component as claimed in any one of

the preceding claims wherein the cross-sectional area is constant throughout the light transfer component.

7. The light transfer component as claimed in any one of the preceding claims wherein the solid angle of the propagating light is substantially constant throughout the light transfer component.

8. The light transfer component as claimed in any one of the preceding claims wherein the first portion is arranged for direct connection to a collector sheet.

9. The light transfer component as claimed in claim 8 wherein the first portion is arranged for face-to-face connection with the collector sheet.

10. The light transfer component as claimed in any one of claims 1 to 7 wherein the first portion comprises a light collector sheet.

11. The light transfer component as claimed in claim 10 wherein the light collector sheet and the light transfer component are formed as an integral part.

12. The light transfer component as claimed in any one of the preceding claims formed from a flexible material.

13. The light transfer component as claimed in any one of the preceding claims wherein the material comprises a polymeric material.

14. The light transfer component as claimed in any one of the preceding claims wherein the material comprises poly

methyl methacrylate (PMMA).

15. The light transfer component as claimed in any one of the preceding claims wherein the second portion is of a rounded cross-sectional shape that is solid.

16. The light transfer component as claimed in claim 15 comprising an intermediate portion that is hollow.

17. The light transfer component as claimed in claim 15 or 16 wherein the second portion is arranged for direct connection to the optical cable.

18. The light transfer component as claimed in claim 17 wherein the second portion is arranged for face-to-face connection with an optical cable.

19. The light transfer component as claimed in any one of 1 to 14 wherein the second portion is of a hollow ring-like shape.

20. The light transfer component as claimed in claim 19 wherein the second portion is arranged for connection to a coupler that is arranged for connection to an optical cable.

21. The light transfer component as claimed in claim 20 wherein the coupler is a hollow-to-solid coupler.

22. A light transfer component having:

- a first portion having two substantially parallel surfaces, and
- a second hollow portion being of a ring-like cross-

sectional shape and being arranged for connection to a hollow-to solid coupler.

23. A light transfer component having:

- a first portion having two substantially parallel surfaces, and
- a second hollow portion being of a rounded cross-sectional shape that is solid and being arranged for connection to an optical cable.

DATED this 23rd day of OCTOBER 2002

UNIVERSITY OF TECHNOLOGY, SYDNEY

By their Patent Attorneys

GRIFFITH HACK

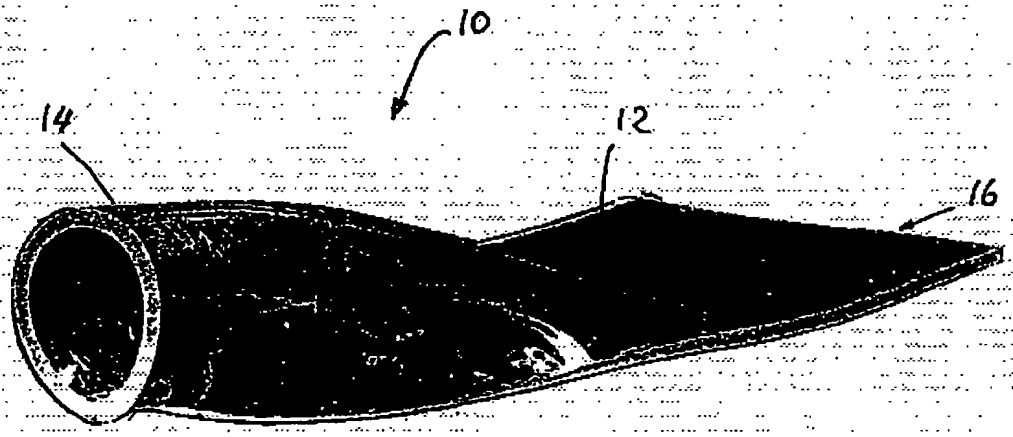


FIG. 1

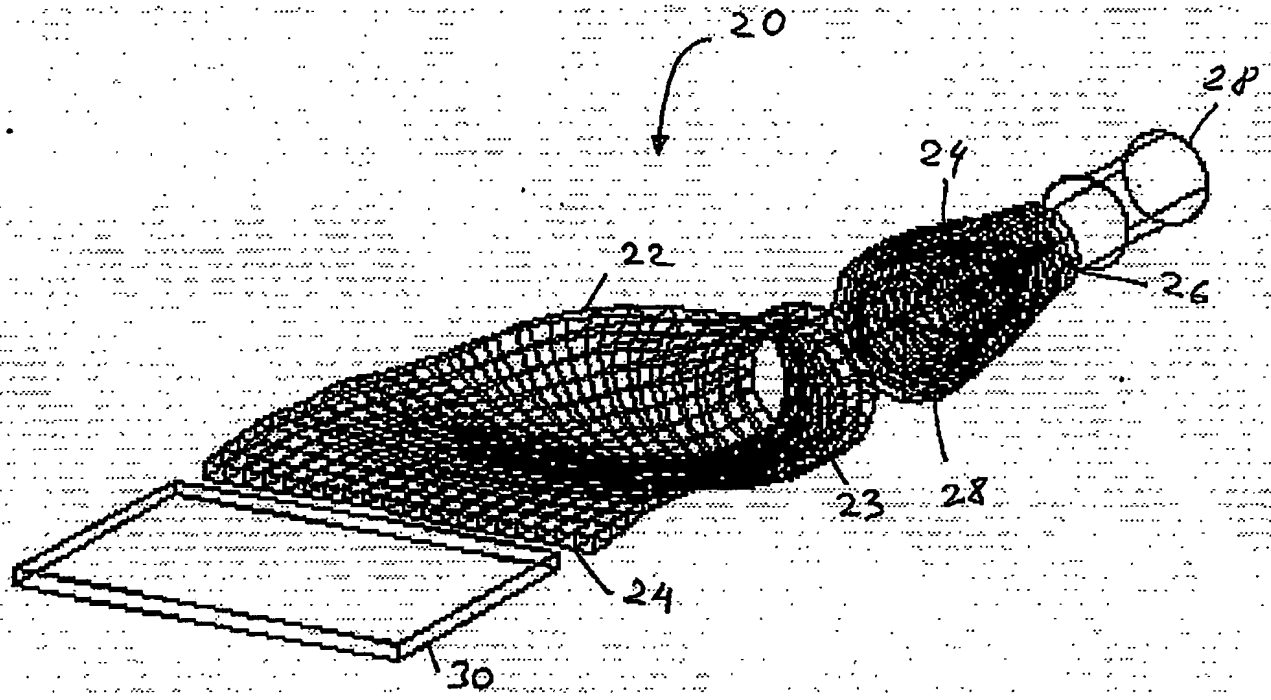


FIG. 2

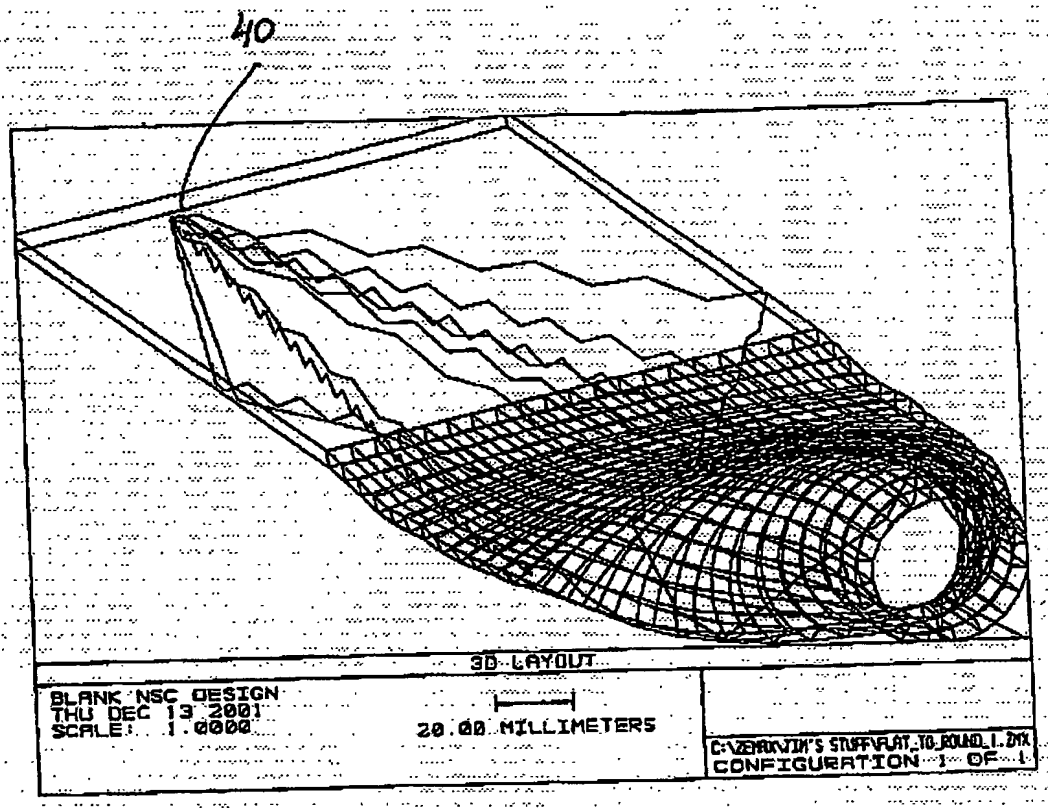
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FIG. 3

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